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## DIGITAL DESIGN & SAFETY

The Floyd Hill project promises to improve Colorado's Interstate 70

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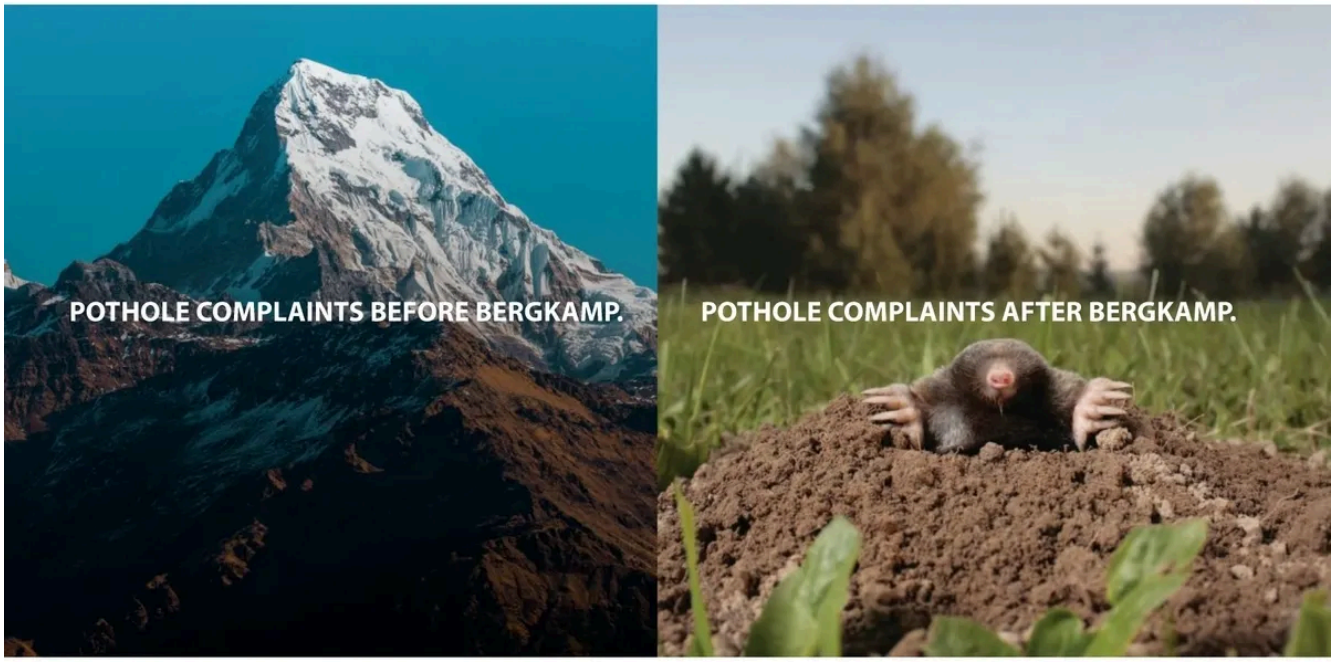


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**An aerial photo of Interstate-70 in Colorado before construction. 3D roadway renderings were developed to confirm proposed design safety goals. The award-winning project has relied on technology to make this busy highway safer for motorists.**

Photo credit: AtkinsRéalis

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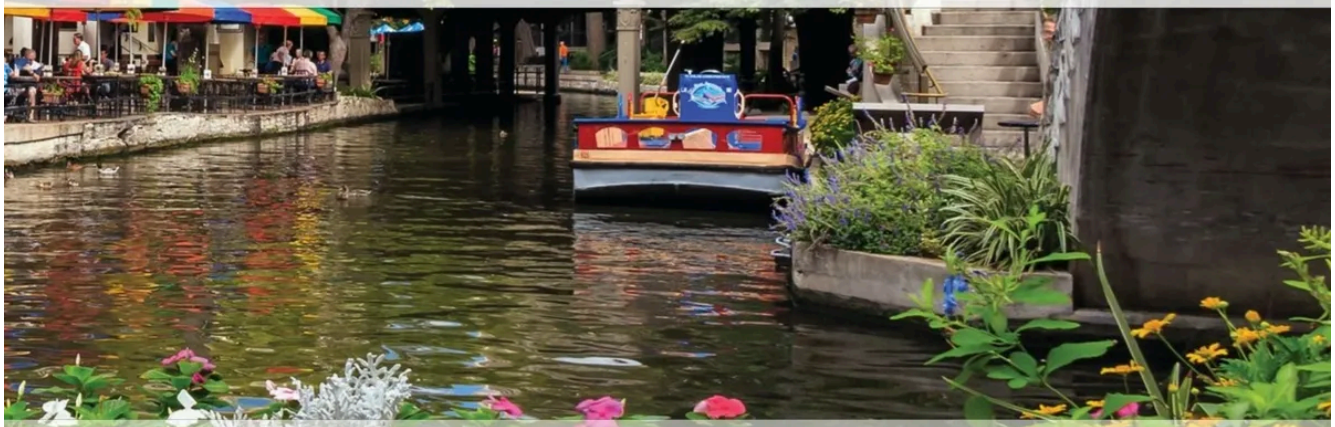

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# Save the Manuals

## We would probably be safer if everyone drove stick

**LAST MONTH,** I was walking my dog along Negley Avenue, a busy road that stretches through four neighborhoods in the east end of Pittsburgh.

Bob, my 6-year-old border collie-mix, stopped to sniff a telephone pole, and I looked up to watch cars as they passed.

That's when I saw a man reading a book as he drove.

In 2021, distracted driving claimed the lives of 3,522 people in America, according to the National Highway Traffic Safety Administration.

Usually, the distraction is a phone. But a book?

This guy's head wasn't even on a swivel. My man was focused on the book, which he held up under the rearview mirror.

"Automatics were a mistake," I said.

My dog didn't understand, but I imagine many of you do.

If this clown had been driving a car with a manual transmission, reading a book probably would have been too much of a challenge to try.

The same goes for texting, eating, or recording a video for TikTok.

I know some people will read this and think, "I can drive stick and eat."

Good for you, buddy. You're the big winner. For the rest of us, driving a manual forces attention to be paid. Your eyes, hands, and feet are in motion with the vehicle.

You operate the car, and there is a mind meld with the engine. The connection is a feeling, a vibe — human working in unison with machine.

A person driving a manual would be more likely to see a work zone coming, and they would be forced to down shift, decreasing their speed. But we have been moving away from manuals for decades.

In 1980, the year I was born, 34.6% of cars had manual transmissions. In 2000, more than 15% of new and used cars that were sold in America were stick shifts. In 2020, that number had dropped to 2.4%.

The "Save the Manuals" online campaign started in 2010, but the effort has failed. There are hundreds of new car models for sale in this country, and only about 30 can come in stick.

When manuals are extinct, we will be stuck with automatics, which are so boring that one man in Pittsburgh thinks he can read a book as he drives.

Boredom is one of the root causes of the distracted drivers crisis. Automatics are so easy to operate that people forget how dangerous it is to drive a car.

So, as the engine shifts itself, the bored driver looks for a new form of stimulation by chaning the song or podcast, or reading the text message they just received.

It's not an age thing, either. The man reading a book looked to be in his 50s or 60s, and I've seen older drivers on their phones, too.

I wish we could save manuals, but we're headed in the opposite direction with autonomous vehicles. That's how bored we are by driving.

We've chosen convenience over control, and it has cost us safety. R&B

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# All According to Plan

## Exact measurements go a long way

**IN DECEMBER 2013,** a contractor agreed to replace four bridges for the Vermont Agency of Transportation (VTrans). Three bridges were completed on time. The fourth bridge involved the construction of a single-span steel girder bridge over the White River in Rochester, Vt. One abutment was to be placed on a deep pile foundation while the other was planned to be placed on the ledge/bedrock.

The contractor conducted some exploratory drilling and discovered the elevation of the ledge was much lower than shown on the plans. The contractor claimed this was a differing site condition that required significant changes. Schultz Construction, Inc. v. Vermont Agency of Transportation, 209 Vt. 146 (2018).

To prove a differing site condition, the contractor had to show that: one, the conditions shown in or represented by the contract differed from the actual conditions; two, the actual conditions were reasonably unforeseeable based on all information available at bid time; three, the contractor reasonably interpreted and relied upon such information; and four, the contractor was damaged thereby.

> **The court reiterated that the contractor need not have had the only reasonable interpretation.**

VTrans determined there were only two representations in the plans as to the ledge elevation. One plan sheet indicated the existing ledge was "approximately" 802 feet. Another plan sheet was a conceptual drawing and "not to scale," so it was unreliable from which to determine ledge elevations. Additionally, VTrans argued the soil borings nearest the expected ledge showed substantial slopes, from which the contractor could not have reasonably expected to use the ledge for placement of the footings. VTrans concluded there were no representations as to what the contractor should have expected and/or the contractor's interpretation was unreasonable in light of such uncertainty.

The contractor appealed to the Transportation Board. The board rejected VTrans' determination and found four plan sheets depicted elevations drawn to scale and used the general symbol for exposed ledge. The board also noted that the bid documents described that the footings for the prior bridge were situated directly on the ledge, so the replacement bridges could be similarly situated. Moreover, the contractor offered significant testimony from its own experienced principal and its consulting engineer.

The board concluded there were at least five separate contract representations supporting the contractor's reasonable interpretation.

Nevertheless, VTrans appealed the board's decision to the Vermont Supreme Court. The court reiterated that the contractor need not have had the only reasonable interpretation.

VTrans' and the contractor's interpretations could be reasonable and, if all other elements are met, then a claim for differing site conditions could still survive, as it did here.

Among other arguments, VTrans contended that the representation of the elevation as "approximate" was enough to make any inferences therefrom unreasonable. The court rightfully held that a reasonable interpretation cannot be solely dependent upon a single statement. Rather, a reasonable interpretation must be based upon the contract as a whole and complete document. Together, the bid information supported the contractor's reasonable interpretation and expectation that the ledge was situated to support the footings for the new bridge.

VTrans also argued that specific plan notes were more important over general depictions of the ledge. The court did not address the often-cited maxim of contract interpretation that specific representations control over generalities. Instead, the court determined the contractor's interpretation of the general representations was reasonable. Had this or other facts been found in VTrans' favor, the outcome could have been the opposite.

In a claim for differing site conditions, the element of reasonably interpreting contract representations is a fact-specific issue in each case requiring careful attention to detail. When each party can have a reasonable interpretation, a fact (or a few) one way or the other can control the entire outcome. Had the facts been more one-sided, this dispute likely would not have progressed through so many levels and to the highest court of the state. R&B

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# DIGITAL DESIGN AND SAFETY

## The Floyd Hill project promises to improve Colorado's Interstate 70

By Brad Dennard, Contributing Author

*The following story outlines an AtkinsRéalis project that won at Bentley's 2023 Going Digital Awards in Infrastructure in the Roads and Highways category. The awards were announced at Bentley's Year in Infrastructure conference in Singapore in October.*

**FOR YEARS, INTERSTATE** 70 has been an essential gateway to the Rocky Mountains for adventurers, vacationers, and sightseers in Colorado. This east-west highway climbs over and through narrow mountain passages. Yet few stretches on this interstate are as frustrating as the Floyd Hill segment between Evergreen and Idaho Springs.

A familiar bottleneck to travelers, it has been described as the "waist of an hourglass," where three lanes shrink to two along a 6% grade. This stretch of road also weaves through a narrow canyon, while connecting to the always busy U.S. Route 6 (U.S. 6).

It's estimated that some 70,000 vehicles drive on this highway each weekend.

Many of the corridors' existing roadway elements are inadequate for today's traffic volume and travel speeds. This section of I-70 has not had significant improvements since its original construction in the 1960s, according to the Colorado Department of Transportation (CDOT).

The result: A less than optimal safety condition for vehicles.

These roadway elements include narrow shoulders, tight horizontal curves, reduced sight distance, and outdated roadside barriers.

The above aerial photo is of Interstate-70 in Colorado before construction. Inset: 3D roadway renderings were developed to confirm proposed design safety goals.
CREDIT: ATKINSRÉALIS

Several years ago, CDOT initiated the I-70 Floyd Hill project, a $700 million, multi-year effort to reconstruct this 7-mile stretch of highway.

The Floyd Hill project is facilitated through a construction manager/general contractor (CMGC) procurement. The challenge for AtkinsRéalis, the lead designer and engineer-of-record, was to improve safety, mobility, operations, and maintenance, minimize construction and economic impacts, gain stakeholder commitment and partnership, and enhance environmental stewardship.

Rethinking this corridor was a study of intense coordination, communication, and creativity. It also was an opportunity to use the team's specialized 3D optioneering expertise, which was facilitated by an engineering-quality digital twin prototype—a virtual replica of Floyd Hill's existing and future conditions. The digital twin prototype continues to provide value to the customer, the contractor, and various stakeholders as construction ramps up on this critical project.

## A MODEL FOR MODIFICATION

Alternatives for corridor improvements were broad and comprehensive. Key components included the addition of a westbound express lane, an eastbound climbing lane, new bridges, and an improved interchange and frontage road access to U.S. 6, as well as wildlife passageways, air quality monitoring stations, and the full reconstruction of a nearby trail.

Early on, the AtkinsRéalis team developed a virtual representation of the highway along the Floyd Hill corridor. Initially, the team used site surveys to generate a model of existing conditions. Aerial

imagery on top of that model provided additional context. That early model became the foundation for initial environmental assessments as well as studies to determine right-of-way impacts.

Once developed, the engineering team could use the data to prepare and evaluate design alternatives. Bridges, foundations, abutments, and walls were analyzed, designed, and modeled utilizing parametric bridge modeling software. The results were then coordinated with specialized design modeling software and overlaid on top of the existing conditions model.

The combination of solutions, including model-centric engineering design software and real-time visualization software, helped the team quickly evaluate and envision impacts and improvements to driver safety, construction and the environment, quantities, cost, and constructability helping to narrow down alternatives that best met the project goals.

Those same engineering models proved invaluable because they became a foundation for communication to the non-engineering community.

**A crew works on rock scaling and soil nail wall construction for roadway realignment on the Floyd Hill Project in Colorado.**
CREDIT: COLORADO DEPARTMENT OF TRANSPORTATION.

## VIRTUAL AND VISUAL FORUM

As expected on a high-profile project such as Floyd Hill, the job communicating with CDOT, stakeholders and the public with a forum. It was crucial for everyone involved to understand and evaluate various alternatives.

With modern technology, the team generated visual imagery directly as a by-product of the engineering model—it's no longer a separate task.

The team created visualizations, fly-through videos, and 360-degree virtual reality images, directly within that singular environment. In essence, the Floyd Hill team has a continually updated model of the proposed design at any given point in time superimposed over existing conditions.

Collaboration with a large, multi-regional, diverse, internal design group (190 design and modeling experts from 10 offices), as well as external consultants and stakeholders including the contractor, during the design process has been critical to the design of the Floyd Hill project.

Throughout the evaluation of alternatives, designers, and engineers updated alignments and reprocessed the model on demand to communicate with stakeholders and the client.

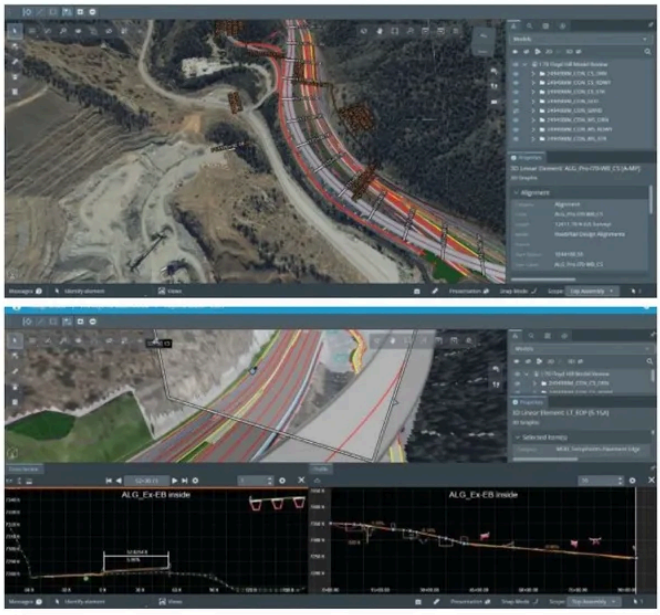
## A ZIG, A ZAG AND A LONG VIADUCT

Ultimately, CDOT selected the canyon viaduct alternative for the Floyd Hill project. The same digital twin prototype that was used to evaluate alternatives would be used to refine the design concept with an eye to construction safety/accessibility, environment, and aesthetics.

The larger project is broken up into three sections: east, central and west.

The east section spans from County Road 65 to the bottom of Floyd Hill. Construction includes the addition of a westbound express lane that will connect with the existing westbound Mountain Express Lane. This increases traffic capacity and eliminates the existing bottleneck.

An eastbound I-70 climbing lane will be constructed from a new U.S. 6 ramp to eastbound I-70 to allow heavy commercial or slow-moving vehicles




**Using advanced 3D models like these helped the Floyd Hill Project win an award at Bentley's 2023 Going Digital Awards in Infrastructure. Advnaced 3D modeling and web-based applications allow real-time review of design details within the context of the proposed model.**
CREDIT: ATKINSRÉALIS